

CLAIMS

1. A positioning system for detecting the position of a terminal, comprising:

5 an illumination device configured to transmit unique information from a given installation position;

 a terminal configured to receive the unique information transmitted from the illumination device; and

 position estimation means configured to estimate the
10 position of the terminal based on the unique information received by the terminal.

2. The positioning system according to claim 1, wherein

15 the unique information is illumination identification information for uniquely identifying the illumination device.

3. The positioning system according to claim 1 or claim 2, wherein

20 the position estimation means is configured to:

 manage illumination installation position information including the unique information and position information indicating the installation position of the illumination device in association with each other;

25 read out, from the illumination installation position information, the position information corresponding to the unique information received by the terminal; and

 estimate the position of the terminal based on the read out position information.

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4. The positioning system according to claim 3, wherein

 the position estimation means is configured to estimate

the position of the terminal based on one or more unique information received by the terminal within a past predetermined time period.

5 5. The positioning system according to claim 4,
wherein

the position estimation means is configured to estimate the position of the terminal based on the unique information received by the terminal most recently.

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6. The positioning system according to claim 4,
wherein

the position estimation means is configured to estimate the position of the terminal based on most frequently
15 received unique information among one or more unique information received by the terminal within a past predetermined time period.

20 7. The positioning system according to claim 4,
wherein

the position estimation means is configured to:
add a weighting value to one or more unique
information received by the terminal within a past
predetermined time based on the reception time of the
25 respective unique information; and
estimate the position of the terminal based on
unique information selected based on a result of the
addition.

30 8. The positioning system according to claim 4,
wherein

the position estimation means is configured to:
increase the weighting value as the reception time

becomes newer;

select unique information having the largest value
resulting from the addition; and

estimate the position of the terminal based on the
5 selected unique information.

9. The positioning system according to any of claims 1
to 8, wherein

the illumination device comprises a light emission unit
10 for emitting an illumination light and a transmission unit
for transmitting the unique information.

10. The positioning system according to claim 9,
wherein:

15 the transmission unit comprises a white LED for
emitting a visible light signal; and

the white LED is configured to transmit the unique
information on the visible light signal.

20 11. The positioning system according to claim 9,
wherein:

the transmission unit comprises an infrared LED for
emitting an infrared ray signal; and

the infrared LED is configured to transmit the unique
25 information on the infrared ray signal.

12. The positioning system according to claim 9,
wherein:

the transmission unit comprises a wireless
30 communication unit for transmitting a radio signal; and

the wireless communication unit is configured to
transmit the unique information on the radio signal.

13. The positioning system according to any of claims
9 to 12, wherein

the transmission unit is configured to transmit the
unique information to the terminal at random timing.

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14. The positioning system according to any of claims
9 to 13, wherein:

the illumination device comprises a power source unit;
and

10 each of the light emission unit and transmission unit
is configured to be separatable from the power source unit.

15. The positioning system according to claim 14,
wherein

15 each of the light emission unit and transmission unit
is connected to the power source unit using a power source
interface of a fluorescent tube for a fluorescent
illumination device.

20 16. The positioning system according to claim 15,
wherein

each of the light emission unit and transmission unit
incorporates a power conversion unit.

25 17. The positioning system according to claim 16,
wherein

the power conversion unit is configured to convert an
AC power supplied from the power source interface of a
fluorescent tube into a DC power used by the light emission
30 unit and transmission unit.

18. The positioning system according to claim 15,
wherein

the light emission unit uses a fluorescent tube, and the transmission unit incorporates the power conversion unit.

5 19. The positioning system according to claim 18, wherein

the power conversion unit is configured to convert an AC power supplied from the power source interface of a fluorescent tube into a DC power used by the transmission
10 unit.

20. The positioning system according to claim 18, wherein

the power conversion unit comprises an overcurrent
15 protection circuit for protecting the power source unit of the fluorescent illumination device.

21. The positioning system according to claim 18, wherein

20 the power conversion unit comprises a power holding circuit for holding a power required for transmission of the unique information.

22. The positioning system according to claim 18,
25 wherein

two electrode terminals, which are the power source interface of a fluorescent tube, formed at one side of the fluorescent tube and power input terminals, which are connected to the power conversion unit for supplying a power
30 to the transmission unit, are electrically connected in parallel to each other.

23. The positioning system according to claim 22,

wherein:

the fluorescent tube is a straight fluorescent tube having two electrode terminals respectively on both sides thereof;

5 the straight fluorescent tube further comprises a power acquisition unit which is connected in parallel to the two electrode terminals formed at one side thereof and acquires a power to be supplied to the power conversion unit; and

10 the power acquisition unit is formed into a plate having two holes through which the two electrode terminals are inserted.

24. The positioning system according to claim 23, wherein

15 the power acquisition unit has a thickness of 1.3 mm or less.

25. The positioning system according to claim 14, wherein

20 each of the light emission unit and transmission unit is connected to the power conversion unit using a power source interface of an incandescent light bulb for an incandescent light bulb illumination device.

25 26. The positioning system according to claim 25, wherein

the light emission unit and transmission unit incorporate a power conversion unit.

30 27. The positioning system according to claim 26, wherein

the power conversion unit is configured to convert a DC power voltage supplied from the power source interface of an

incandescent light bulb into a voltage form that the light emission unit and transmission unit use.

28. The positioning system according to any of claims
5 9 to 13, wherein:

the illumination device comprises a solar battery unit;
and

the transmission unit is configured to transmit the
unique information by using a power supplied from the solar
10 battery unit.

29. The positioning system according to claim 28,
wherein

the solar battery unit is configured to convert a light
15 energy output from the light emission unit into an
electrical power.

30. The positioning system according to claim 28,
wherein:

20 the illumination device comprises a rechargeable
battery for storing a power supplied from the solar battery
unit; and

the transmission unit is configured to transmit the
unique information when a power required for the
25 transmission of the information has been stored in the
rechargeable battery.

31. The positioning system according to any of claims
9 to 30, wherein

30 the transmission unit is configured to determine an
angle at which the unique information is transmitted
depending on the size of the area within which the unique
information can be received and installation level of the

illumination device.

32. The positioning system according to any of claims 9 to 30, wherein

5 the transmission unit is configured to determine the number and output power of LEDs constituting the transmission unit that transmits the unique information depending on the size of the area within which the unique
10 information can be received, installation level of the illumination device, gain characteristics of a receiver of the terminal for receiving the unique information, and output characteristics of the LEDs constituting the transmission unit that transmits the unique information.

15 33. The positioning system according to claim 32, wherein

the transmission unit comprises a plurality of LEDs for emitting a light signal, the LEDs being configured to transmit the unique information on the light signal in
20 different directions.

34. The positioning system according to claim 33, wherein

the transmission unit is configured to determine the
25 number of LEDs that transmit the unique information depending on a difference in the transmission direction between the adjacent two LEDs, transmission angles of LEDs, size of the area within which the unique information can be received, and installation level of the illumination device.
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35. The positioning system according to any of claims 1 to 34, wherein

the illumination device is configured to emit a light

having a color indicating that it is transmitting the unique information.

36. The positioning system according to any of claims
5 1 to 34, wherein
the illumination device is configured to emit a light
using different colors for each service type.

37. The positioning system according to any of claims
10 1 to 34, wherein
the illumination device is configured to emit a light
using different colors for each service provider providing a
service using the position information of the terminal.

38. The positioning system according to claim 36 or
15 claim 37, wherein
the illumination device is configured to illuminate the
area within which the terminal can receive the unique
information with an illumination light.

39. The positioning system according to any of claims
20 1 to 38, wherein
the illumination device comprises a storage unit for
storing the unique information.

40. The positioning system according to any of claims
25 3 to 39, wherein
the illumination installation position information is
configured to be created by associating the unique
30 information collected by the terminal and installation
position of the illumination device with each other.

41. The positioning system according to any of claims

1 to 40, wherein:

the positioning system further comprises a second positioning system; and

the positioning system and second positioning system
5 can be operated in a switchable manner.

42. The positioning system according to claim 41, wherein

the second positioning system is a positioning system
10 using a wireless LAN.

43. The positioning system according to claim 41 or claim 42, wherein

the positioning system is configured to identify the
15 position of the terminal by using the unique information that the illumination device transmits, in the case where requested terminal position information is logical position information.

20 44. The positioning system according to claim 41 or claim 42, wherein

the positioning system is configured to identify the position of the terminal by using the second positioning system, in the case where the positioning system could not
25 identify the position of the terminal by using the unique information.

45. The positioning system according to claim 41 or claim 42, wherein

30 the positioning system is configured to determine whether to identify the position of the terminal by using the unique information or by using the second positioning system, based on the type of the requested terminal position

information.

46. The positioning system according to any of claims
1 to 45, wherein

5 the positioning system is configured to display
acquired terminal position information.

47. The positioning system according to claim 46,
wherein

10 the positioning system is configured to switch a
display method of position information depending on the
accuracy of acquired terminal position information.

48. The positioning system according to claim 46 or
15 claim 47, wherein

the positioning system has a function of storing
attribute information concerning the terminal and of
displaying the position information of the terminal
corresponding to specified attribute information.

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49. The positioning system according to claim 48,
wherein

the positioning system is configured to store, as the
attribute information of the terminal, a name of a
25 department to which a terminal user belongs.

50. The positioning system according to any of claims
46 to 49, wherein

the positioning system is configured to display the
30 terminal position information corresponding to a specified
display condition.

51. The positioning system according to claim 50,

wherein

the positioning system is configured to specify, as the display condition, information of floors in which the terminal exists.

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52. The positioning system according to any of claims 1 to 51, wherein

the illumination device comprises a rechargeable battery and is configured to transmit information by using a power supply from the rechargeable battery in the case where it cannot use a power source thereof.

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53. The positioning system according to any of claims 1 to 52, wherein

15

the positioning system is configured to:

identify a user terminal in response to a position information request concerning a user of the terminal; and acquire the position information of the identified terminal.

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54. The positioning system according to claim 53, wherein

the positioning system is configured to select one terminal in order of priority set for the respective terminals to acquire the position information thereof, in the case where a plurality of the user terminals exist.

25

55. The positioning system according to claim 54, wherein

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the priority is configured to be determined based on the type of the terminal.

56. The positioning system according to claim 54,

wherein

the priority is configured to be determined such that the position information of the terminal using a wireless LAN has a higher priority.

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57. The positioning system according to claim 54, wherein

the priority is configured to be determined based on presence/absence of a response from the terminal.

10

58. The positioning system according to claim 54, wherein

the priority is configured to be determined based on the use state of the terminal.

15

59. A positioning method of a positioning system for detecting the position of a terminal, comprising:

transmitting unique information using an illumination device from a given installation position thereof,

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receiving the unique information transmitted from the illumination device using a terminal; and

estimating the position of the terminal based on the unique information received by the terminal.

25

60. The positioning method according to claim 59, wherein

the unique information is illumination identification information for uniquely identifying the illumination device.

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61. The positioning method according to claim 59 or claim 60, further comprising:

storing illumination installation position information including the unique information and position information

indicating the installation position of the illumination device in association with each other;

reading out the position information corresponding to the unique information from the stored illumination

5 installation position information based on the unique information received by the terminal; and

estimating the position of the terminal based on the read out position information.

10 62. The positioning method according to any of claims 59 to 61, wherein

a white LED is used as a light emission source of the illumination device and the unique information is transmitted by using a visible light signal emitted by the
15 white LED.

63. The positioning method according to any of claims 59 to 61, wherein

the unique information is transmitted by using an
20 infrared ray signal emitted by an infrared LED.

64. The positioning method according to any of claims 59 to 61, wherein

the unique information is transmitted by using a radio
25 signal.

65. The positioning method according to any of claims 59 to 64, wherein

the unique information is transmitted to the terminal
30 at random timing by the illumination device.

66. The positioning method according to any of claims 59 to 65, wherein

in the case where the light emission unit and transmission unit of the illumination device are connected to a power source unit by means of a power source interface of a fluorescent tube for a fluorescent illumination device,
5 the light emission unit and transmission unit convert an AC power supplied from the power source interface of a fluorescent tube into a DC power.

67. The positioning method according to any of claims
10 59 to 65, wherein

in the case where the light emission unit and transmission unit of the illumination device are connected to a power source unit by means of a power source interface of an incandescent light bulb for an incandescent light bulb
15 illumination device, the light emission unit and transmission unit convert a DC power voltage supplied from the power source interface of an incandescent light bulb into a voltage form that they can use.

20 68. The positioning method according to any of claims 59 to 67, further comprising

determining an angle at which the unique information is transmitted from the illumination device depending on the size of the area within which the unique information can be
25 received and installation level of the illumination device.

69. The positioning method according to any of claims 59 to 68, further comprising

determining, in the case where a plurality of LEDs are
30 arranged in the illumination device so as to emit the unique information in different directions, the number of LEDs that transmit the unique information depending on a difference in the transmission direction between the adjacent two LEDs;

transmission angles of LEDs, size of the area within which the unique information can be received, and installation level of the illumination device.

5 70. The positioning method according to any of claims 61 to 69, further comprising:

collecting the unique information by using a terminal that can receive the unique information that the illumination device transmits; and

10 creating the illumination installation position information to be stored in a positioning system by associating the position at which the unique information is received and received unique information with each other.

15 71. The positioning method according to any of claims 59 to 70, further comprising

identifying, in the case where position detection processing can be switched between the positioning system and a second positioning system and where a terminal position information request is logical position information, the position of the terminal by using the unique information that the illumination device transmits.

25 72. The positioning method according to claim 71, wherein

a positioning method carries out by the second positioning system is a positioning method using a wireless LAN.

30 73. The positioning method according to claim 71 or 72, further comprising

identifying, in the case where the position of the terminal could not be identified by using the unique

information, the position of the terminal by using the second positioning system.

74. The positioning method according to claim 71 or
5 claim 72, further comprising

determining whether to identify the position of the terminal using the unique information or using the second positioning system based on the type of the requested position information.

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75. A program for a positioning server in a positioning system,

the positioning system including an illumination device which transmits unique information from a given installation
15 position, a terminal which receives the unique information, and a positioning server realized by a computer connected in a communicable manner to a terminal and detecting the position information of the terminal based on the unique information received by the terminal,

20 the program allowing a computer serving as the positioning server to function as position estimation means configured to estimate the position of the terminal based on the unique information that the terminal has received.

25 76. The program according to claim 75, wherein the position estimation means is configured to:

read out, from illumination installation position information in which the unique information and position information indicating the installation position of the
30 illumination device are associated with each other, the position information corresponding to the unique information based on the unique information received by the terminal; and

estimate the position of the terminal based on the read out position information.

77. A program for an application server in a
5 positioning system,

the positioning system including an illumination device which transmits unique information from a given installation position, a terminal which receives the unique information, and an application server realized by a computer connected
10 in a communicable manner to a terminal and detecting the position of the terminal based on the unique information received by the terminal,

the program allowing a computer serving as the application server to function as display means configured
15 to display the position information of the detected terminal.

78. The program according to claim 77, wherein the display means is configured to switch a display method of position information depending on the accuracy of
20 acquired terminal position information.

79. The program according to claim 77 or claim 78, wherein

the display means is configured to:
25 store attribute information concerning the terminal; and
display the position information of the terminal corresponding to specified attribute information.

80. The program according to any of claims 77 to 79, wherein

the display means is configured to display the terminal position information corresponding to a specified display

condition.

81. The program according to any of claims 77 to 80,
wherein

5 the program further allows the computer serving as the
application server to function as acquisition means
configured to:

 receive a position information request concerning
a terminal user;

10 identify the terminal that the user uses; and
 acquire the position information of the identified
terminal.

82. The program according to claim 81, wherein
15 the acquisition means is configured to, in the case
where a plurality of the user terminals exist, select one
terminal in order of priority set for the respective
terminals to acquire the position information thereof.

20 83. The program according to claim 82, wherein
 the acquisition means is configured to determine the
priority based on the type of the terminal.

84. The program according to claim 82, wherein
25 the acquisition means is configured to determine the
priority such that the position information of the terminal
using a wireless LAN has a higher priority.

85. The program according to claim 82, wherein
30 the acquisition means is configured to determine the
priority based on presence/absence of a response from the
terminal.

86. The program according to claim 82, wherein
the acquisition unit is configured to determine the
priority based on the use state of the terminal.

5 87. The positioning system according to claim 18,
wherein
the power conversion unit comprises protection means
for supplying a DC power to the transmission unit only when
an electrical connection between the power conversion unit
10 and transmission unit is established.

88. The positioning system according to claim 87,
wherein:
the protection means comprises current detection means,
15 determination means, and switching means;
the current detection means is configured to detect the
output current value of the power conversion unit and
notifies the determination means of the detected output
current value;
20 the determination means is configured to compare the
notified output current value and a previously set threshold
value; and
in the case where the output current value is smaller
than the threshold value, output of a DC power is stopped by
25 the switching means, while in the case where the output
current value is larger than the threshold value, a DC power
is output by the switching means.

89. The positioning system according to claim 18,
30 wherein
the power conversion unit and transmission unit are
connected by a connection interface, the connection
interface comprising insulating means configured to prevent

an electrical contact from outside at connection time.

90. The positioning system according to claim 89,
wherein

5 the connection interface is an electrode covered by an
insulating body.

91. The positioning system according to any of claims
1 to 40, wherein:

10 the terminal is carried by a person entering a
specified area; and

the positioning system comprises:

entering person detection means configured to detect
the person who has entered the specified area;

15 entering person information management means configured
to manage information concerning the person who has entered
the specified area;

leaving person detection means configured to detect a
person who has left the specified area;

20 leaving person information management means configured
to manage information concerning the person who has left the
specified area; and

remainder identification means configured to identify a
person who remains in the specified area, wherein

25 the remainder identification means is configured to:

compare entering person information managed by the
entering person management means and leaving person
information managed by the leaving person information
management means;

30 identify a person who has entered the specified
area but has not left the specified area as a remainder; and

identify the position of the terminal carried by
the remainder.

92. The positioning system according to claim 91,
wherein

the terminal comprises:

5 signal reception means configured to receive the unique
information transmitted from the illumination device; and
 information transmission means configured to transmit
the received unique information and terminal identification
information on a radio signal, wherein
10 the position of the terminal is identified based on the
unique information and terminal identification information
transmitted from the terminal.

93. The positioning system according to claim 92,
15 wherein

the information transmission means utilizes a PHS.

94. The positioning system according to claim 91,
wherein

20 the entering person detection means and leaving person
detection means are constituted by:

a plurality of the illumination devices installed near
a gateway to the specified area;

 storage means configured to store the unique
25 information and terminal identification information; and
 moving direction detection means configured to detect
the moving direction of the person carrying the terminal
from the stored unique information and terminal
identification information,

30 wherein:

the terminal, which is carried by a person who passes
through the gateway from outside of the specified area and
enters or leaves the specified area, is configured to:

receive the unique information transmitted from the illumination device; and

use the storage means to store the received unique information and terminal identification information;

5 the moving direction detection means is configured to:

refer to a change of the unique information transmitted from the specified terminal stored by using the storage means;

10 estimate the moving direction of the person carrying the terminal;

detect the person as an entering person in the case where the moving direction is toward the inside of the specified area; and

15 detect the person as a leaving person in the case where the moving direction is toward the outside of the specified area.

95. The positioning system according to claim 92, wherein

20 the storage means is set outside the terminal, and the terminal and storage means are configured to communicate with each other using the information transmission means.

25 96. The positioning system according to claim 91, wherein

the leaving person detection means configured to detect, as a leaving person, the person carrying the terminal that has received the unique information transmitted from the illumination device installed outside the specified area.

30

97. The positioning system according to claim 91, wherein

the positioning system is configured to be switched to a second positioning system.

5 98. The positioning system according to claim 92,
wherein

the second positioning system is configured to identify the position of a PHS base station with which the terminal communicate, as the position of the terminal.

10 99. The positioning system according to claim 91,
wherein

the entering person detection means comprises:

a reading device configured to:

15 store information for the person to identify him
or herself; and

read out the information from a second terminal carried by the person; and

20 an entrance permission device which allows the person
to enter the specified area in the case where readout of the
information succeeds, wherein

the entering person information management means is storage means configured to store the information of the person allowed to enter the specified area.

25 100. The positioning system according to claim 91,
wherein

the leaving person detection means comprises:

a reading device configured to:

30 store information for the person to identify him
or herself; and

read out the information from a second terminal carried by the person; and

an exit permission device configured to allow the

person to leave the specified area in the case where readout of the information succeeds, wherein

the leaving person information management means is storage means configured to store the information of the
5 person allowed to leave the specified area.

101. The positioning system according to claim 91, wherein

the leaving person detection means comprises:

10 a reading device configured to:

store information for the person to identify him or herself; and

read out the information from a second terminal carried by the person;

15 an exit permission device which allows the person to leave the specified area in the case where readout of the information succeeds or a request from outside is received,
a plurality of the illumination devices installed near the gateway to the specified area;

20 storage means configure to store the unique information and terminal identification information; and

moving direction detection means configured to detect the moving direction of the person carrying the terminal from the stored unique information and terminal

25 identification information, wherein

in the case where the exit permission device allows the person to leave the specified area in response to a request made from outside irrespective of success or failure of the readout of the information,

30 the terminal, which is carried by the person who enters the specified area through the gateway and leaves from the specified area, is configured to;

receive the unique information transmitted from

the illumination device: and

use the storage means to store the unique information and terminal identification information; and

the moving direction detection means is configured to:

5 refer to a change of the unique information transmitted from the specified terminal stored by using the storage means;

estimate the moving direction of the person carrying the terminal; and

10 detect the person as a leaving person in the case where the moving direction is toward the outside of the specified area.

102. The positioning system according to any of claims 15 99 to 101, wherein:

the second terminal is a noncontact IC card; and the reading device is a card reader.

103. The positioning system according to any of claims 20 1 to 40, wherein

the transmission unit is installed to a fixing body such that the direction in which the transmission power of the transmission unit becomes maximum is downward.

25 104. The positioning system according to claim 103, wherein

a receiver of the unique information that the terminal has is attached to a moving body such that the direction in which the reception gain of the receiver becomes maximum is 30 upward.

105. The positioning system according to any of claims 1 to 40, wherein

the transmission unit is installed to a fixing body such that the direction in which the transmission power of the transmission unit becomes maximum is horizontal.

5 106. The positioning system according to claim 105, wherein

the receiver is attached to a moving body such that the direction in which the reception gain of the receiver becomes maximum is horizontal.

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107. The positioning system according to claim 106, wherein

two receivers are attached to the moving body.

15 108. The positioning system according to claim 107, wherein

the two receivers are attached to a moving body such that the directions in which the reception gains of the receivers become maximum are right and left, respectively.

20

109. The positioning system according to any of claims 106 to 108, wherein

the positioning system is configure to determine entering/leaving of the moving body into/from a specified
25 zone based on the unique information received by the receiver.

110. The positioning system according to any of claims 106 to 108, wherein

30 the positioning system is configure to determine the direction of the moving body based on the unique information received by the receiver.